

# The Heard Island and McDonald Islands Marine Reserve and Conservation Zone – A model for Southern Ocean marine reserves?

by

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**ABSTRACT.** - Recognition of the unique and largely unmodified nature of the marine environment within the Australian EEZ around Heard Island and the McDonalds Islands led to the proposal for a marine reserve in 2001. The reserve was designed based on all scientific data available at the time, including data on biota and geophysical features of the area, the principles of comprehensiveness, adequacy and representativeness of the protected areas, as well as providing control areas for assessing the performance of the marine reserve and impacts of fishing. In October 2002, following consultation with stakeholders, an area covering over 65 000 km<sup>2</sup> was declared as an IUCN category Ia marine reserve. Some additional areas, where consensus could not be reached, became a Conservation Zone, with a process agreed to provide an assessment of the conservation values and fishing potential in the Zone. With the assistance of industry vessels, research fishing and benthic surveys have been conducted inside and outside the Conservation Zone. On the basis of these data, an agreement is now close to being reached which is likely to see portions of the Conservation Zone join the Marine Reserve, with the remainder reverting to be part of the Australian Fishing Zone. A similar procedure, based on a precautionary approach and satisfying criteria of comprehensiveness, adequacy and representativeness, including Conservation Zones to focus research on contentious areas while affording some level of interim protection, could be followed to facilitate the establishment of a system of marine protected areas elsewhere.

**RÉSUMÉ.** - La réserve marine et la zone de conservation des îles Heard et McDonald – Un modèle pour les réserves marines de l'océan Austral ?

La reconnaissance de la nature unique et largement préservée de l'environnement marin présent autour de l'île Heard et des îles McDonald à l'intérieur de la ZEE australienne a conduit à la proposition d'une réserve marine en 2001. La réserve fut décidée sur la base de toutes les données scientifiques disponibles à ce moment, en incluant celles sur les aspects biologiques et géophysiques de la région, les principes de portée, d'adéquation et de représentativité des aires protégées, aussi bien que la possibilité de fournir des aires de contrôle pour accéder aux performances de la réserve marine et ses impacts sur la pêche. En octobre 2002, à la suite de consultation avec les décideurs, une surface dépassant 65 000 km<sup>2</sup> fut déclarée comme réserve marine selon le statut Ia de l'IUCN. Quelques aires additionnelles, où le consensus ne pouvait être atteint, devinrent une zone de conservation, avec un processus accepté permettant de réaliser une évaluation des valeurs de conservation et du potentiel de pêche dans cette zone. Avec l'assistance des navires de l'industrie de la pêche, des campagnes de recherche de pêche et de prospection benthique ont été réalisées tant à l'intérieur qu'à l'extérieur de la zone de conservation. Sur la base des données obtenues, un accord est sur le point d'être conclu dans lequel il est probable que des parties de la zone de conservation vont rejoindre la réserve marine, le restant étant reversé à la partie de la zone de pêche australienne. Une procédure similaire fondée sur une approche de précaution et répondant aux critères de portée, d'adéquation et de représentativité, incluant des zones de conservation pour promouvoir la recherche sur les zones à contentieux et disposer d'un certain niveau de protection intérimaire, pourrait être suivie pour faciliter ailleurs la mise en place d'un système d'aires marines protégées.

Key words. - Kerguelen Plateau - Heard Island - Southern Ocean - Marine protected area - Reserve design.

When it was established in 2002, the Heard Island and McDonald Islands (HIMI) Marine Reserve was the largest marine protected area (MPA) in the world, and at 65 000 km<sup>2</sup> still remains one of the largest. Other marine reserves, such as those very recently established in the Chagos Archipelago (544 000 km<sup>2</sup>), and in 2009 in the South Orkney Islands (94 000 km<sup>2</sup>) are much larger in terms of total area. How-

ever, the HIMI Marine Reserve remains unique for the large area of submarine plateau and banks in the Southern Ocean under the International Union for the Conservation of Nature (IUCN) category Ia protection within it.

There is a clear mandate for establishing and managing marine protected areas in all the world's oceans following, for example, the implementation plan for Agenda 21 of the

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United Nations World Summit on Sustainable Development in 2002. In this paper, we review the development of protection of the marine environment at HIMI, the processes that lead to the establishment of the HIMI Marine Reserve and Conservation Zone, and recent work that is continuing to enhance the understanding and management of threats to the unique conservation values in this region.

### Management of the marine environment at Heard Island and the McDonald Islands

Following the discovery in 1853 of Heard Island, and the McDonald Islands in 1854, both were formally claimed by the United Kingdom in 1910. As noted elsewhere in this volume (Duhamel and Williams, 2011), environmental protection was apparently not the primary concern of the administrators of these islands during the first century after their discovery. In 1947, the islands were transferred to the Commonwealth of Australia to become the Territory of Heard Island and the McDonald Islands, and Australian law began to be applied to the region with the enacting of the Heard Island and McDonald Islands Act 1953. During this period, Australia claimed territorial waters 12 nm from the low water line.

Management of the offshore marine environment at HIMI commenced with the declaration in 1979 of the Australian Fishing Zone (AFZ), which extended 200 nm out from the low water mark, abutting to the north and north-west with the Exclusive Economic Zone (EEZ) declared by France in 1978 around Kerguelen Islands. In 1980, Australia became one of the original signatories of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). The Convention covers all marine areas of the Southern Ocean south of a line approximating the position of the Antarctic Convergence, including the HIMI AFZ as part of CCAMLR Statistical Division 58.5.2, and came into effect in 1982. In 1981, Australia enacted the Antarctic Marine Living Resources Conservation Act establishing the process by which conservation measures established under CCAMLR, such as those to regulate harvesting of fish, would be applied under Australian law including all Australian or foreign fishing vessels operating in the HIMI AFZ. In 1991, the Fisheries Management Act came into force, regulating fishing by all Australian and foreign vessels within the AFZ around HIMI. In 1994, with the ratification by Australia of the United Nation Convention on the Law of the Sea, the AFZ became recognised as part of Australia's EEZ.

### The Heard Island Wilderness Reserve and World Heritage Area

The islands within the Territory were added to the Register of the National Estate in 1983, obligating the Australian Government to avoid any action which would cause any adverse effect to their heritage values. Recognition and pro-

tection of the unique natural heritage values found within the territory, including Australia's only active volcanoes, large populations of seabirds and marine mammals, and an environment almost entirely free of anthropogenic modification or introduced species, was advanced further in 1987 by the Heard Island and McDonald Islands Environment Protection and Management Ordinance (EPMO), which remains in force. This ordinance explicitly noted the need "...to preserve and manage the Territory so as to protect the environment and the indigenous wildlife of the Territory." While the EPMO does not explicitly mention the marine environment, it requires a permit to enter the Territory of HIMI (including the 12 nm territorial sea surrounding the islands) and provides a high level of protection from human interference for the biota and geological features within the Territory. The EPMO also created an obligation to develop a management plan for the Territory.

In 1990, Australia made a submission for the inclusion of the Territory of HIMI on the World Heritage list (DASETT, 1990). The application was deferred as the World Heritage Committee requested additional details including claims as to the uniqueness of HIMI relative to other subantarctic islands. In 1992, a review of legislation applying to HIMI noted that a management plan was still pending. It noted that even with World Heritage status, some potentially threatening activities could still be permitted, and recommended the establishment of a nature reserve (House of Representatives Standing Committee on Legal and Constitutional Affairs, 1992). In 1995, the Heard Island Wilderness Reserve Management Plan was published (AAD, 1995), and the Heard Island Wilderness Reserve was established in 1996, with the Australian Antarctic Division responsible for the administration of the Reserve. In 1997, the Territory of HIMI was added to the World Heritage list, with the World Heritage Committee recognising the unique geology and subantarctic flora and fauna, and also requesting further information on the marine environment (UNESCO, 1997). Also in 1997 the first exploratory fishing by Australian vessels for Patagonian toothfish (*Dissostichus eleginoides* Smitt 1898) and mackerel icefish (*Champsocephalus gunnari* Lönnberg 1905) commenced under a fishery plan administered by the Australian Fisheries Management Authority. This plan included an additional 1 nm buffer zone beyond the territorial sea included in the Wildlife Reserve, where transit by fishing vessels was allowed but fishing was prohibited.

### The mandate for a Marine Reserve at Heard Island

In 1992, Australia signed the Convention on Biological Diversity at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil. To address its obligations under this treaty, the Australian Government developed the National Strategy for the Conservation of Australia's Biological Diversity. This included an objective

to “establish and manage a comprehensive, adequate and representative system of protected areas covering Australia’s biological diversity”, including a National Representative System of Marine Reserves (NRSMPA) and, as one of eight principles for implementing the strategy that:

“Central to the conservation of Australia’s biological diversity is the establishment of a comprehensive, representative and adequate system of ecologically viable protected areas.” (Commonwealth of Australia, 1996).

It was also noted that areas with unique conservation value should be given special protection.

In 1998, the Interim Marine and Coastal Regionalisation for Australia (IMCRA) Technical Group published version 3.3 of a bioregionalisation of all marine ecosystems within the Australian EEZ (IMCRA Technical Group, 1998). This report identified a single bioregion around HIMI, named the Kerguelen Province. The IMCRA Technical Group noted that the region supported important populations of breeding seals and seabirds, and the endemic Heard Island cormorant (*Phalacrocorax atriceps nivalis* Falla, 1937), and also noted the importance of the region as a study area for the impact of climate change on the oceans and atmosphere. No further details on marine taxa such as fish or invertebrates were included, and further subdivision of the province into smaller scale regions was not performed. Also in 1998, Australia’s Oceans Policy (Commonwealth of Australia, 1998) was released and noted the development of a marine reserve at HIMI as one of five priority areas for inclusion in the NRSMPA.

In 1999, the Australian and New Zealand Environment and Conservation Council (ANZECC), commissioned by Environment Australia, produced a strategic plan outlining the steps to achieving the RSMMPA (ANZECC TFMPA, 1999). This plan reiterated the primary goal of the NRSMPA as establishing and managing a comprehensive, adequate and representative system of protected areas across all of Australia’s maritime jurisdictions. It also expanded on the comprehensiveness, adequacy and representativeness (CAR) principles, defining them as follows:

**Comprehensiveness:** The NRSMPA will include the full range of ecosystems recognised at an appropriate scale within and across each bioregion.

**Adequacy:** The NRSMPA will have the required level of reservation to ensure the ecological viability and integrity of populations, species and communities.

**Representativeness:** Marine areas selected for inclusion in MPAs should reasonably reflect the biotic diversity of the marine ecosystems from which they derive.

The plan also established the adoption of a precautionary approach such that the absence of scientific data would not be a reason to postpone the establishment of a protected area, and also that the NRSMPA would aim to include some highly protected areas in each bioregion (equivalent to IUCN

protected area management categories I and II). Also in the same year, the Environmental Protection and Biodiversity Conservation Act (hereafter referred to as ‘the Environment Act’) came into force, providing the process for the establishment and management of marine reserves, as well as explicitly prohibiting any activities that might significantly impact on the marine environment, and killing or injuring any marine birds and seals without a permit.

### Review of marine habitats at Heard Island and the McDonald Islands

To redress the lack of a synthesis of data to assist with the evaluation of reserve design at HIMI, the Australian Antarctic Division was commissioned by Environment Australia to review all available data on the conservation values in the marine environment in the region. Meyer *et al.* (2000) provided a comprehensive review of geophysical, oceanographic and biological data. Combining a range of physical variables, including bottom depth and topography, sediment type and mobility due to wave disturbance, water temperature and salinity, as well as the influence of components of the Antarctic Polar Front as it flows around and across the Kerguelen Plateau around HIMI, led to the identification of 12 distinct physical units within the EEZ, comprising the five banks (Aurora, Coral, Pike, Discovery and Shell), the Territorial waters, the Southern, Northern and Northeastern shallow plateau, Eastern and Western Troughs and all the deeper waters to the south (Fig. 1).

Meyer *et al.* (2000) noted a relative paucity of quantitative biological data for the region, particularly for the invertebrate fauna, due to the low numbers of scientific surveys conducted, particularly outside of the Territorial waters. Plateau-wide data was limited to that of fish and echinoderms derived from demersal fish surveys conducted by the *Aurora Australis* during the early 1990s (Williams and de la Mare, 1995), and commercial trawlers since the fishery commenced in 1997. The authors noted that there was a general tendency for taxa to vary from west to east across the region. For example, the banks on the west of the plateau (Coral and Aurora) showed evidence of diverse benthic communities including large gorgonians, deep-sea acorn barnacles (*Bathylasma* spp.) and gorgonocephalid ophiuroids not present in samples taken elsewhere, and to the east Shell Bank supported a distinct population of *C. gunnari* and the only large aggregations of *Lepidonotothen squamifrons* (Günther 1880) as well as a unique assemblage of benthic taxa including glass sponges and the only records of several holothuroid and asteroid species. The northern, central and southern parts of the shallow plateau also showed evidence for distinct benthic and fish communities, with some echinoderm families such as the Benthoeptinidae, Labiasteridae and Chiridotidae being restricted to samples taken on the central plateau, and *C. gunnari* being primarily found on the south-

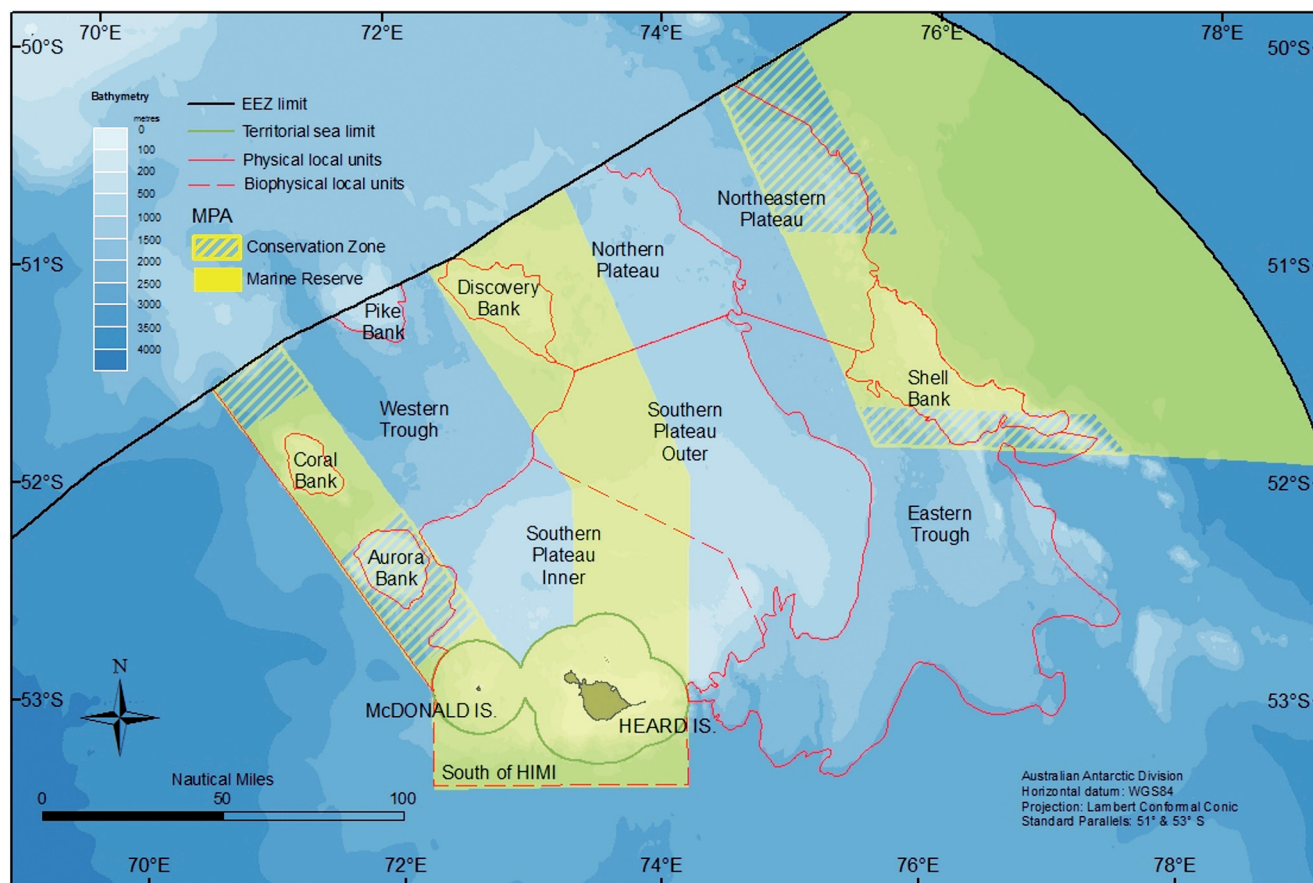


Figure 1. - The location of the physical local units (solid red line) and biophysical local units (as for the physical units except for the additional subdivision of the Southern Plateau and South of HIMI units, dotted red line) developed by Meyer *et al.* (2000) and their relationship to the Heard Island and McDonald Islands Marine Reserve and Conservation Zone declared in 2003 within the Australian EEZ.

ern part of the plateau. These analyses effectively confirmed that the different habitats represented by the physical local units tended to contain distinct faunal communities, as well as leading to the further subdivision of the southern section of the plateau into outer and inner areas (Fig. 1).

### The proposal and declaration of the HIMI Marine Reserve

Meyer *et al.* (2000) included a proposal for the configuration of the HIMI Marine Reserve, to protect unique benthic areas, as well as representative pelagic features exploited by land-breeding marine predators. Following the CAR principles, the design incorporated a portion of nearly all biophysical local units, as well as featuring a number of 'spokes' radiating out from the Territory, to provide connectivity between areas (e.g., to allow migration of juvenile fish from shallow nursery areas to deeper waters) as well as to provide long term protection even as species distributions change due to factors such as climate change. The configuration of the reserve was also designed to provide a framework for testing the effects of fishing by having similar types of areas inside

and outside the reserve, which also provided the foundation for monitoring the performance of the reserve over time. With the release of the proposal by Environment Australia, a consultation process, as required under the Environment Act, was commenced. The HIMI Stakeholder Group (HSG) was formed, comprised of members from the policy and research branches of AAD, the fishing industry and non-government conservation organizations.

There was general agreement by the HSG with the scientific rationale and design principles for the proposed reserve, and that the majority (85%) of the proposed area should receive a high level of protection. However, the HSG was unable to reach consensus as to the inclusion or exclusion of four areas – Aurora Bank, a portion of the Western Trough north of Coral Bank, the Eastern Trough north of Shell Bank and a portion of southern Shell Bank. The Environment Act provides for the establishment of a conservation zone to provide interim protection to an area while it is assessed for possible inclusion in a reserve, and the HSG agreed to include the four areas in a conservation zone pending further research to establish the conservation values in



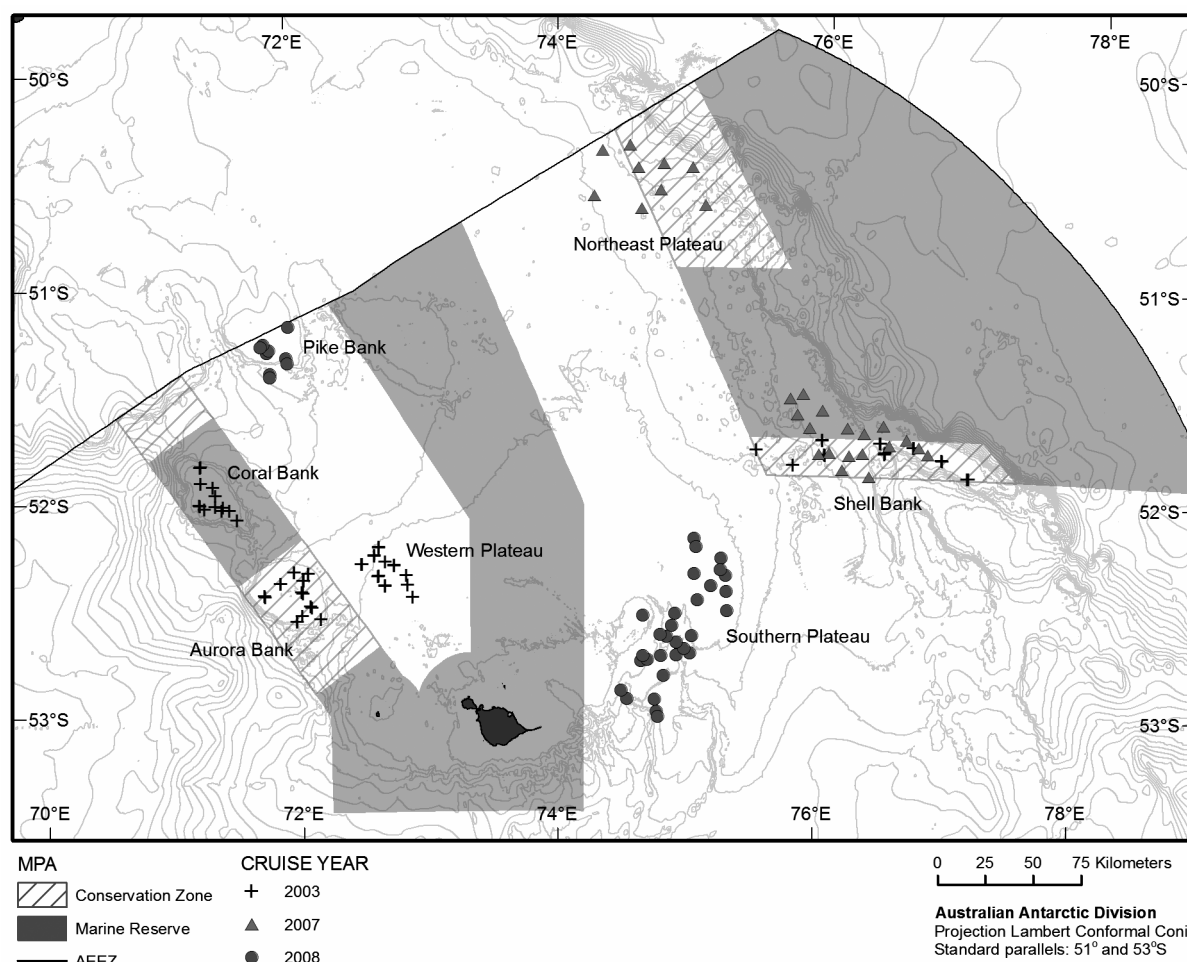


Figure 2. - Sampling conducted since 2003 to evaluate benthic biodiversity in the Heard Island and McDonald Islands Marine Reserve and Conservation Zone. Isobaths are 200 m depth increments.

these areas, the representativeness of areas already in the Marine Reserve, the potential impact of fishing on conservation values, and the importance of fish resources to the overall viability of the HIMI fishery. In 2002, the HIMI Marine Reserve and Conservation Zone was established (Fig. 1). With the Reserve covering 65 000 km<sup>2</sup>, it ranked as the largest IUCN category Ia marine protected area in the world, and it is still the second largest 'no take' reserve (equivalent to IUCN categories I and II) in the Australian EEZ, after the Great Barrier Reef Marine Park at 115 240 km<sup>2</sup>.

#### Research in the HIMI Reserve and Conservation Zone

Research activities in the HIMI reserve are conducted under permits issued by the AAD under the Environment Act. Since 1997, and continuing since the establishment of the Reserve, an annual random stratified trawl survey to assess the distribution and abundance of demersal fishes has been conducted from aboard a commercial trawler and routinely includes stations inside the Marine Reserve (Welsford

*et al.*, 2006; Nowara, 2009) to ensure a comprehensive picture of the fish stocks on the plateau < 1000 m deep. Outside the Marine Reserve, the spatial distribution of toothfish fishing is not proscribed, and as stock assessments for toothfish and mackerel icefish are conducted on the entire stock within the HIMI EEZ (e.g., Candy and Constable, 2008), there has been no need to adjust catch limits to account for area within the Reserve. Limited commercial fishing has also occurred in all four areas of the Conservation Zone as part of the evaluation of fishery resources in these areas.

Extensive benthic beam trawl and sled sampling has also occurred (Fig. 2); in 2003 as part of an AAD and fishing industry funded research project to evaluate the biodiversity inside and outside the Reserve and the Conservation Zone, and in 2007 and 2008 as part of a large collaborative project involving AAD, the Australian fishing industry, the Australian Fisheries Management Authority and the Fisheries Research and Development Corporation entitled 'Demersal fishing interactions with marine benthos in the Austral-

Table I. - Characteristics of the thirteen biophysical units identified by Meyer *et al.* (2000) and their protection status in 2010 within the Heard Island and McDonald Islands Marine Reserve and Conservation Zone. Biological and physical characteristics summarized from Meyer *et al. (ibid.)*, Hibberd *et al.* (2010), and AAD unpublished data.

Local unit	Physical characteristics	Biological characteristics	Protection status
Aurora Bank	Flat topped bank rising to 300-500 m, western edge of the plateau influenced by ACC waters	Rich benthic community, with high biomass of large sponges, brachiopods and bryozoans, and significant quantities of soft corals, anemones and gorgonians. Taxa with limited ranges including pycnogonids and echinoderms, as well as highest recorded diversity of gastropods in the region are also noteworthy.	Entirely within CZ – some of shallow (< 500 m) areas being considered for addition to the Reserve.
Coral Bank	Flat topped bank rising to 300-500 m, western edge of the plateau influenced by ACC waters	Rich benthic community, with high biomass of barnacles and brachiopods, gorgonians and other sessile taxa.	Entirely within the Reserve.
Discovery Bank	Rounded bank rising to 300-400 m, above the northern plateau. Influenced by ACC water diverted through the western trough.	Fauna dominated by anemones, sponges and asteroids. Notable examples of tall glass sponges found here.	Entirely within the Reserve.
Pike Bank	Flat topped bank rising to 300-500 m, with steep, rugged eastern slope. Influenced by ACC water diverted through the western trough.	Very high biomass of sessile invertebrates including sponges. Has similar fauna to Coral and Aurora Banks, with the exception of several site restricted species including an asteroid, ophiuroid and bivalve, and high diversity of sipunculids.	Outside the Reserve
Shell Bank	Relatively large flat topped bank, with steep southern slopes incised by canyons. Influenced by northward retroflexion of ACC after deflection to the south by the shallow plateau, and eddies in the lee of the shallow plateau.	Very diverse benthic communities, showing high numbers of taxa and highest numbers of endemic or site restricted taxa of any local unit, including pycnogonids, echinoderms, brachiopods and corals. Supports a distinct sub population of <i>Champscephalus gunnari</i> as well as aggregations of <i>Lepidonotothen squamifrons</i> , and is a nursery area for <i>Dissostichus eleginoides</i> . Important foraging area for air breathing predators.	Most of bank within Reserve, some within CZ. Additional areas (<500m) being considered for addition to the Reserve.
Territorial Sea	Nearshore waters, 0-300 m. Shallow areas influenced by wave action.	Diverse inshore and shallow plateau fauna, showing the greatest diversity of taxa, including with several echinoderms with distributions restricted to this unit. Nearshore foraging area for birds such as the Heard Island cormorant.	Entirely within the Reserve.
Southern Plateau Inner	Flat sand and silt substrate in depths from 200 m to 500 m. Shallow areas influenced by wave action.	Diverse fauna (particularly echinoderms) intergrading between inshore and shallow plateau assemblages. The only records of holothuroid <i>Psolidium incertum</i> (Théel, 1886) in the region are from this unit. Important juvenile habitat for <i>C. gunnari</i> . Important foraging area for air breathing predators.	Central portion within the Reserve.
Southern Plateau Outer	Flat sand and silt in depths 200 m to 500 m. Influenced by relatively warm ACC waters in the north and west and colder waters form the Eastern Trough in the east.	Faunistic similarities with adjacent plateau areas. Notable for high diversity polychaetes and pycnogonids. Important juvenile habitat for <i>D. eleginoides</i> . Primary adult habitat for <i>C. gunnari</i> around Gunnari Ridge in the east of the unit.	Western portion within the Reserve.
Northern Plateau	Narrow shallow plateau (~500 m) between deeper areas to the east and Discovery Bank. Seafloor uneven. Influenced by colder waters flowing north from the eastern trough and warmer waters flowing east	Not well sampled. Likely to have some faunistic similarities with adjacent plateau areas.	Western portion within the Reserve.

Table I. - Continued.

Local unit	Physical characteristics	Biological characteristics	Protection status
Northeastern Plateau	Deeper plateau with some highly rugose areas (500-750 m). Influenced by colder waters flowing north from the eastern trough and warmer waters flowing east.	Faunistic similarity to Shell Bank, though lower diversity and abundance of taxa. Isopods in the family Idoteidae restricted to this unit and Shell Bank. The lanternshark <i>Etmopterus</i> sp. largely restricted to this unit. Important foraging area for air breathing predators.	SE portion within the Reserve. NE portion within the CZ. Some of NE area being considered for addition to the Reserve.
Eastern Trough	Trough extending from the shallow northern plateau to the deeper slopes south of Shell Bank. Influenced by northward retroflexion of ACC after deflection to the south by the shallow plateau.	Faunistic similarities to the Northeastern Plateau. Includes some restricted deep water taxa such as the carid <i>Pasiphaea</i> . Important foraging area for air breathing predators.	Part of NE within the Reserve and the CZ. Some of NE area being considered for addition to the Reserve.
Western Trough	Deep trough. Diverts ACC water up onto the shallow plateau.	Fauna similar to Coral and Aurora Banks, with high biomass of gorgonians and other sessile taxa. Several species with distributions restricted to this unit including pycnogonids, opisthobranchs and anemones. Likely corridor for toothfish between shallow plateau and deeper water spawning areas along the western margin in the Australian and French EEZs. Supports relatively high densities of skates and grenadiers.	Part of western area included in the Reserve and the CZ. Some of NW area being considered for addition to the Reserve.
South of HIMI	Steep southerly facing slopes, incised by canyons. Influenced by ACC diverted south by the shallow plateau	Biota poorly sampled. Likely to support diverse communities due to topographic complexity, ACC influence and adjacent shallow and deep water habitats.	Entirely within the Reserve.

ian EEZ of the Southern Ocean: an assessment of the vulnerability of benthic habitats to impact by demersal gears'. This sampling has greatly expanded the amount of information available on the biodiversity in the region (Hibberd and Moore, 2009; Hibberd *et al.*, 2010), confirming that there is substantial heterogeneity in habitats and benthic assemblages at the mesoscale (10s to 100s of km) and smaller across the region, as well as confirming the inclusion of representative areas of the majority of local units originally identified by Meyer *et al.* (2000) in the Reserve. Consultations within the HSG regarding the conservation values identified in the Conservation Zone are ongoing, and it is likely that some of these areas will be included in the Marine Reserve, with the remainder reverting to the EEZ (Tab. I).

## CONCLUSION

We consider that the processes that led to the establishment of the HIMI Marine Reserve, and the high level of protection afforded to the unique natural heritage at HIMI provides a useful model for the establishment of other marine protected areas where data is limited. Despite the evidence that a diverse range of marine habitats and taxa were likely to be present in the region, large quantities of data on the

distribution and abundance of biota was not available, and therefore detailed biogeographic analyses, such as those that were applied around continental Australia to produce the IMCRA were not feasible. However, the explicit policy of the Australian Government to take a precautionary approach enabled progress to protect the conservation values known to exist in the region, which were later confirmed to be appropriate.

Although marine species may not experience such obvious barriers to dispersal as their terrestrial counterparts, oceanographic and bathymetric features do limit connectivity between areas, and as a result delineate distinct ecological spaces where different habitats and assemblages are likely to be encountered. Hence the identification of mesoscale local units on the basis of biophysical features in the HIMI EEZ provided a useful mechanism for subdividing the region into areas on an ecological basis, which have since been shown to harbor distinctive faunas. Indeed as more data becomes available, evidence grows for even finer scale biogeographic subdivisions within the region. As a portion of nearly all biophysical units were included in the Reserve, the discovery of finer scale patterns in biodiversity are more likely to be afforded adequate protection, as there is a higher likelihood more combinations of biophysical variables and hence habitats will be represented within the Reserve. Further, as long

term factors such as global changes in the ocean manifest, it provides more ecological space and hence more opportunity for species to adapt and biodiversity to persist.

The provision for a Conservation Zone under the Environment Act also contributes to the robustness of the approach by allowing time for contentious or uncertain areas to be evaluated for inclusion or exclusion in the reserve without eroding future conservation or fisheries values in the interim.

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